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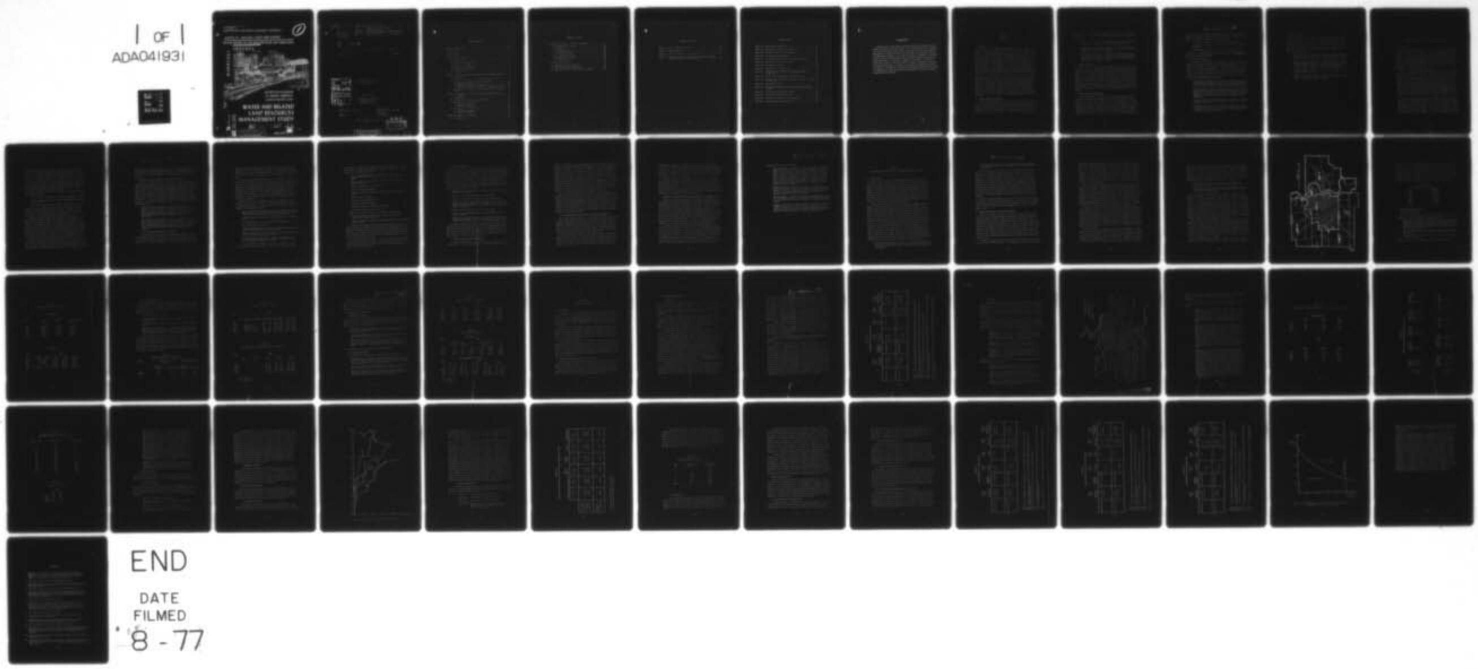

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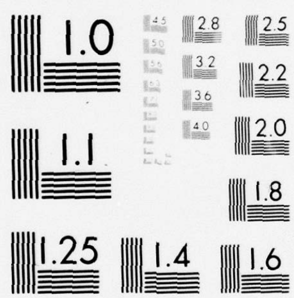

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VOLUME V
SUPPORTING TECHNICAL REPORTS APPENDIX

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ANNEX B - INTASA LAND USE PAPER

REVIEW REPORT ON THE MISSOURI RIVER AND TRIBUTARIES

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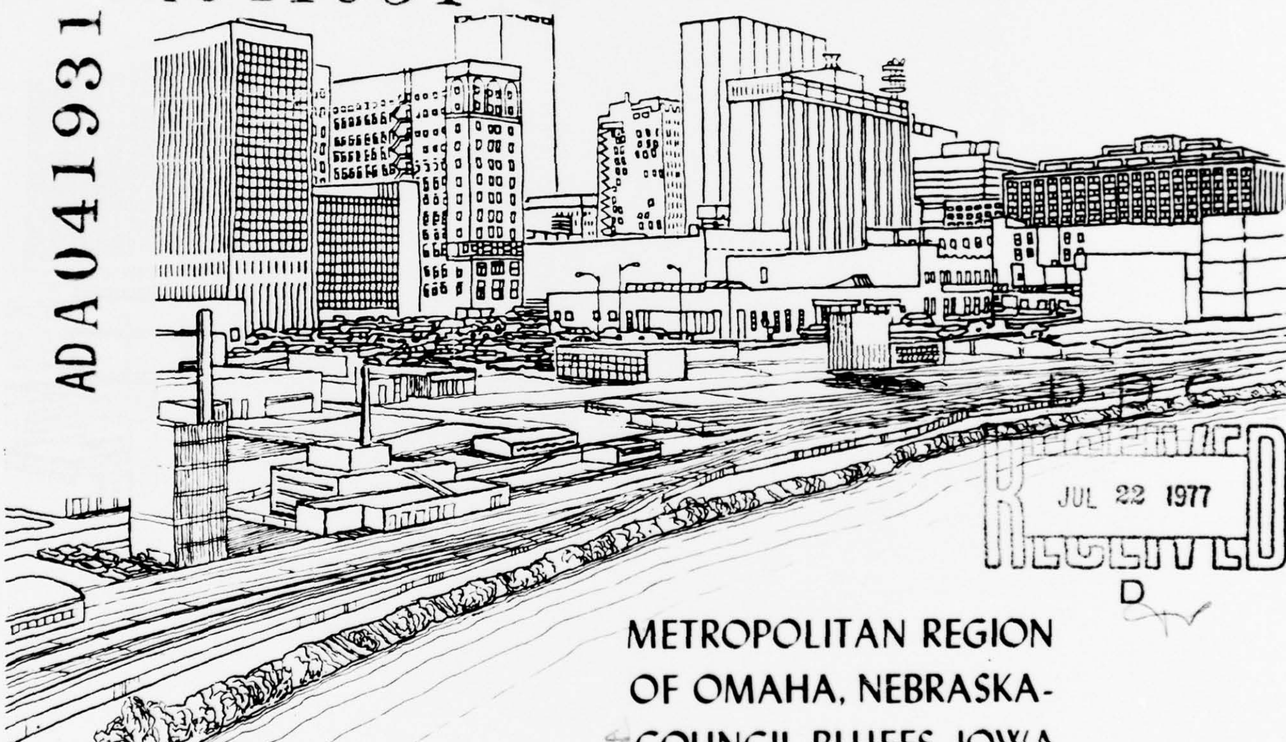

METROPOLITAN REGION
OF OMAHA, NEBRASKA-
COUNCIL BLUFFS, IOWA

WATER AND RELATED LAND RESOURCES MANAGEMENT STUDY

JUNE 1975

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12 55p.

6 Water and Related Land Resources
Management Study.
Volume V. Supporting Technical Reports Appendix.
Annex B. Intasa Land Use Paper.

INTASA

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Issue Paper No. 1

July 1973

A COMPARATIVE ANALYSIS OF ALTERNATIVE LAND USE PATTERNS FOR THE OMAHA AREA

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Contract Number DACW 45-73-C-0027
IRP 72-12

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ACKNOWLEDGMENTS

We would like to thank several individuals who provided assistance and co-operation throughout this crash effort. Messrs. Joe Auburg and John Velehradsky of Missouri River Division and Omaha District respectively were most helpful in delineating the scope of the paper and, in addition, provided overall technical and administrative support. Other Corps personnel who contributed to the effort by providing technical assistance and data as needed throughout the project period include Messrs. D. Kissicki, D. Gjesdahl, R. Musselman, C. Hillerson, J. Kilday and O. Nelson. We are also grateful to Messrs. R. Anderson of the Omaha City Planning Department, R. Martin of the Riverfront Development Program and D. Peterson, T. Eversden and W. Harrison of the Metropolitan Area Planning Agency for extending their full cooperation in gathering data for the land use and socioeconomic impact analyses.

Chapter I

REPORT SUMMARY

A. Background

INTASA has been involved with the Missouri River Division (MRD) and specifically the Omaha District of the Corps of Engineers since July 1972. During this period, INTASA provided assistance in a variety of areas related to the Omaha, Denver and Kansas City Urban Studies. These include (1) organization and presentation of several planning and evaluation workshops for study personnel, (2) implementation of the flood plain management simulation program (SIMULATOR) to the analysis of the Papillion Creek flood plain in Omaha, Nebraska, (3) implementation of the same program to the Sand and Toll Gate flood plain in Denver, Colorado, (4) training of Omaha and Kansas City District personnel in the use and operation of the program, and (5) assistance in development of the Plans of Study for the Omaha and Denver Urban Studies Programs. In a meeting on March 21, 1973, with Mr. Joe [illegible]burg, MRD, and Mr. John Velchradsky, Study Manager - Omaha District, INTASA was informed of a decision that Phase I of the Omaha Urban Study would be concluded through a set of issue papers. To assist in this effort, INTASA undertook responsibility for two issue papers: "A Comparative Analysis of Alternative Land Use Patterns for the Omaha Area" and "Recreation Planning for Flood Control Reservoirs: A Case Study in the Papillion Creek Basin." The first issue paper, developed from the end of March to the end of June 1973, is presented in this report. All work to date has been funded under Contract No. DACW 45-73-C-0027.

B. Scope of Comparative Analysis

The scope of the analysis presented is best defined by the overall objective of this issue paper: to demonstrate the emerging concept that water resource planning should accurately reflect the interaction between land use and water resources so that water resource development plans will be in harmony with projected land use patterns. As a result, the analysis consists of

a broad assessment of several key issues related to land use and their impact on water resources. The following summarizes tasks performed and organization of this paper:

- An exposition of the main reasons for conducting a comparative analysis of land use alternatives when developing alternative urban water resource systems. This discussion is presented in Chapter II.

- A definition of two alternative land use forms for the Omaha, Nebraska-Council Bluffs, Iowa Metropolitan Area. This specification of basic alternatives is presented in Chapter III.

- A discussion of impacts resulting from the development of each land use alternative. This impact analysis was performed using the SIMULATOR to the extent possible: additional analysis was performed outside the scope of the present computer program. The impact analysis and results are presented in Chapter IV.

C. Project Organization

Mr. W. Seelbach was project leader responsible for client contact and organization of work. He was also primarily responsible for the land use analysis framework and pattern specifications presented in Chapters II and III, respectively. Dr. J. Rosing performed most of the work in converting the land use pattern specifications to a form suited for the SIMULATOR. The social analysis in Chapter IV is due to Dr. L. Brekka who also assisted in other parts of the study. The water supply demand analysis was formulated by Dr. C. Jolissaint. The computer runs were made by Dr. J. Rosing assisted by Mr. M. Hilleary and Ms. M. Daniels. Computer calculations of water resource requirements are due to Mr. M. Hilleary and average travel times for each pattern are due to Ms. M. Daniels.

D. Summary of Analysis Framework

Land use is emerging as one of the most critical issues in urban and regional planning and the relationship between land use and water resource development is an important element. No longer can planning be done for one without considering the other. Hence there is a recognized need for a comprehensive water management program such as the Omaha Urban Study to examine this relationship in detail. In order for the water resource planner to design systems that reinforce and contribute to the development of a particular land use pattern, he must answer two questions: what are the pattern's chances of

implementation and what are the pattern's major consequences regarding water resource development. In response to these two concerns, the analysis in this paper is structured to obtain information in regard to:

. Key strengths and weaknesses of major alternative land use patterns.

. Consistency of the patterns in regard to established trends and major parameters.

. Aggregate water resource requirements associated with each pattern.

The analysis is performed using a computer simulation model and limited data collected over a one-month period.

E. Results and Conclusions

The analysis results provide specific information in regard to the framework briefly described in Section D. In particular, economic and social consequences are analyzed, the consistency of alternatives discussed, and aggregate water resource requirements presented. The water resource requirements include water supply demand, wastewater loadings and the need for additional structural flood control. Several sensitivity case studies are included. Analysis results are presented in detail in Chapter IV. The major conclusions and results from the analysis are as follows:

. National Economic Efficiency (NEE) benefits favor higher density development with growth in the City of Omaha, along the Riverfront and in Council Bluffs. The major difference is due to transportation costs, which vary significantly with the compactness of development.

. The social impact of alternative land use plans is a function of the location of new housing and employment opportunities, as well as the magnitude of development. Higher density development with particular attention to the redevelopment of downtown Omaha would be important factors in reversing present trends toward deterioration of the downtown area.

. Density and population distribution have a strong influence on water resources, affecting the magnitude and location of water demand and wastewater flows.

. It appears that for those flood plains in the study area with little existing development, the use of zoning to prevent future residential, commercial or industrial development is economically superior to structural flood control alternatives.

F. Recommendations

The results presented in this paper demonstrate the importance and viability of land use analysis as a necessary input to accomplish water resource development within the multiobjective framework. A possibly more important observation, however, is that land use analysis provides the means through which the Corps of Engineers can significantly assist local governments in urban and regional planning. It is therefore recommended that Phase II of the Omaha Urban Study include:

1. Detailed specification of reasonable alternative land use patterns for the Omaha-Council Bluffs SMSA. These patterns should be developed through full coordination with and participation of local agencies.
2. Analysis of the resulting patterns at a substantially more detailed level and broader scope. Emphasis should be on both the consequences for water resource development, and the choices that each pattern offers to the local citizens. The latter should be the subject of a meaningful public involvement program to assess preferences.
3. Detailed evaluation of impacts in terms of several economic, social and environmental measures.
4. Integration of land use analysis with the design of water resource systems so that the development of water resources will be consistent with the alternative futures envisioned.

Chapter II

FRAMEWORK FOR LAND USE ANALYSIS IN WATER RESOURCE PLANNING

A. Introduction

It is an accepted fact that land use and water resource development are interrelated. There are numerous examples of the impact of land use on water resources and conversely the impact of water resource development on land use, e.g., industrial, commercial and residential land use create different demands for water supply; a flood control reservoir often changes agricultural land use to that of higher order activities such as residential development. Thus, the concept is emerging that planning for water resource development should accurately reflect this interaction so that water resource development will be consistent with projected land use patterns.

First, it is noted that merely recognizing this interaction broadens the range of planning objectives that can be affected by water resource development. That is, providing water resource development plans that are in harmony with alternative land use patterns is seen as inducing the planner to consider objectives beyond those traditionally planned for. Thus, full recognition of this interaction brings water resource planning in line with the multiobjective planning philosophy. Certainly, recognition of this interaction does not by itself define the broader range of objectives for water resource development. That is, definition of such objectives requires a good understanding of the land use pattern so that water resource plans are formulated which contribute to and reinforce the strengths of the pattern while minimizing the adverse effects.

Saying that one must gain a thorough understanding of a given land use pattern in order to develop a consistent set of objectives for water resource development is conceptually pleasing, however there are virtually an infinite number of attributes associated with a land use pattern that could be analyzed; e.g., density, distribution of population, homogeneity of development, recreational opportunities, cost of public services, travel time to place of employment, institutional structure, pollution level, fiscal viability, and so forth.

In order to initially limit the scope of the analysis, this multitude of attributes is treated at a level of detail sufficient to (1) determine the pattern's chances of implementation and, (2) identify its major consequences regarding water resource development. At this level of detail it suffices to assume that the interaction between land use and water resource development, which is iterative in nature, can be captured by using land use patterns as the dominant input to specify the major determinants of water resource development. Subsequent iterations are necessary to refine both the land use pattern and the associated water resource systems.

In response to these two concerns, the analysis is structured to obtain information in regard to:

- Key strengths and weaknesses of major alternative land use patterns.
- Consistency of the patterns in regard to established trends and their major parameters.
- Aggregate water resource requirements associated with each pattern.

In essence then, this Sec. A. chapter offers a framework for the role of land use analysis in water resource planning while subsequent chapters apply this framework to the formulation, specification and analysis of major land use alternatives for the Omaha-Council Bluffs metropolitan area.

Section B presents a more detailed description of the information to be derived through land use analysis. The assessment of major strengths and weaknesses is disaggregated into three elements: economic impacts, social impacts and environmental impacts. The analysis of a pattern's consistency is shown to center on such issues as the match between employment and population, the density of development as a function of distance from the CBD, and the geographical distribution of income groups. The impact of land use on water resource requirements is examined in terms of mgd's demanded, wastewater loading from point sources and impact on flood protection alternatives. Finally the simplified framework as applied in this paper is discussed.

Section C discusses the relationship between the land use analysis framework and the planning process described in the Omaha Plan of Study.? This is done to indicate the purpose of land use analysis in the overall water resource planning process from a somewhat different perspective. It is shown that

land use analysis integrates the first four steps of the planning process--need identification, generation of alternative programs, program analysis and display--through the first iteration, thus offering a way to "cut through" the process.

B. Elements of Land Use Analysis for Water Resource Planning

Analysis of a land use pattern provides necessary input for identifying major water-related purposes and for designing water resource systems. Thus, it can be said that the ultimate objective of land use analysis in water resource planning is to provide the requisite information for designing the best water resource system to meet the water related needs of the land use plan. However, this is not the only objective of such analysis. A land use plan may be unacceptable due to its social, economic and environmental consequences and, therefore, the design of an associated water resource system need not be considered. It can then be stated that land use analysis should have the following two objectives:

- Provide sufficient information so that an assessment can be made regarding a land use pattern's chances of implementation. This assessment is used as an input to determine the chances of implementing associated water resource systems. Such an assessment can be made on the basis of (1) a characterization of the plan's major strengths and weaknesses and (2) a delineation of the pattern's consistency.

- Provide sufficient information so that an assessment can be made of the pattern's influence on water resource development. This assessment includes information characterizing water-related requirements for the development of systems and information characterizing objectives related to the major strengths and weaknesses of the pattern that can be affected by water resource system development and design.

1. Assessment of Major Strengths and Weaknesses

An assessment of major strengths and weaknesses accomplishes two things. (1) It yields information regarding the overall attractiveness of a pattern; if one pattern has significant benefits or costs that another does not, this information is useful in determining the chances for implementing that pattern.

(2) It identifies basic differences and underlying objectives of alternative patterns; this is necessary in order to plan for water resource systems having multiplier effects--effects beyond the provision of traditional water-related needs--which are consistent with and reinforce the objectives of a given pattern.

Assessment of strengths and weaknesses is characterized by analysis of a pattern's major impacts on existing institutions and on the economic, social and environmental domains (Ref. 1). Impacts on institutions are primarily concerned with the political feasibility of reorganization and with financial arrangements that may be necessary to implement a plan. Elements within the remaining three categories can be delineated and analyzed in several ways. The important point, however, still remains: these elements are too numerous for detailed analysis and the planner must determine the most critical ones that merit consideration.

Economic impacts can be categorized in terms of (1) national income, (2) distributional considerations, (3) regional economic stability and (4) cost of community services (Ref.1). Major economic impacts of land use analysis related to these categories include:

- Cost of transportation, measured both in terms of capital requirements and operating costs of the networks and travel costs for the consumer, including travel time and running costs, measured in dollars.
- Cost of development, including both construction and site development costs.
- Cost of providing gas, water, electricity and sewage removal.
- Cost of fire and police services.
- Revenues generated, both to the private and public sectors, including analysis of various tax bases and tax structures.
- Other revenues generated due to net income changes resulting from either changing or intensifying existing land uses.
- Distribution of costs and benefits, including an assessment of who benefits economically from a given pattern and an analysis of how costs are distributed among income groups.

A categorization of social impacts, presented in Reference 1, provides for (1) population displacement and dispersal, (2) employment opportunities,

(3) recreation opportunities, (4) public safety and health, and (5) aesthetic considerations. A more detailed delineation appropriate for land use analysis within the social domain must examine:

- Access to opportunities such as schools, employment, recreation, culture and shopping areas for various income and geographical groups.
- Major aesthetic concerns accounting for the population's makeup and cultural background.
- Population displacement and dispersal.
- Health and safety considerations.
- Employment opportunities and match between employment and population makeup.
- Racial balance and tension.
- Urban/rural balance and migration.
- Urban blight and redevelopment.
- Recreation deficiencies by different activities.
- Housing variety and match with population.

Major environmental impacts of a land use pattern should consider:

- Physical/Chemical/Biological changes in water(aquatic), land (terrestrial) and air(atmospheric).
- Ecological changes in species and populations, habitats and communities, and ecosystems.

An approach to an initial assessment of major environmental impacts is to analyze the pattern's utilization and desecration of the environment. This involves (1) determining the land's suitability for various types of activities and assessing any conflicts between suitability and the proposed land use and (2) assessing the pattern's impact on various categories of pollution such as land, water, air, noise, and so forth.

The above lists of major economic, social and environmental impacts offer a starting point for specific land use analysis. Within each category the critical elements related to a specific pattern will be determined by the planner's intuition and judgement.

2. Consistency Analysis

An assessment of a land use pattern's consistency is used to determine its credibility. Because the water resource planner normally is starting with a land use pattern developed by another agency or firm, he must check the plan to see that it is consistent. This entails assessing the plan's internal consistency, e.g., is the employment level projected consistent with population growth, and external consistency, e.g., how do population and density projections compare with those used in other studies or made by other agencies.

Within this context there are various consistency checks that can be made. For internal consistency, these include:

- Consistency between population and employment, not only in total numbers, but also in skills.
- Consistency between population makeup and housing mix.
- Consistency between density, population and land requirements.
- Consistency in the "logic" of the development, e.g., less expensive land develops first, land closer to employment develops first, decrease in density and increase in income occurs as one moves away from centers of employment.

Concerning external consistency, analysis should examine:

- Consistency of projections and assumptions with other studies and national averages.
- Consistency of pattern with current trends concerning direction of growth and type of development. Where trends are assumed to change, the assumptions on which the inference is based should be examined.

Checking the consistency of land use patterns as defined above requires an analysis framework based on modeling the logical interdependencies of key parameters so that the planner can concentrate on examining the validity of the assumptions made and/or the results obtained. The computer model used for the land use analysis presented in this paper provides this type of tool and, therefore, facilitates consistency checking.

3. Impact on Water Resource Requirements

An assessment of the water resource requirements of a specified land use pattern is used as one piece of information to formulate a water resource

system. Because many resource requirements, such as water supply, are heavily dependent upon land use, an analysis of requirements is a useful starting point in determining major impacts of alternative land use patterns on water resource development. However, in obtaining the full range of a pattern's impact on water resource development and system design, the planner must also translate certain strengths and weaknesses of the land use pattern into objectives that will broaden the choice among alternative systems. This is done so as to include systems that satisfy more complex objectives in addition to the traditional water requirements. For example, assessment of waste loadings offers an input to the design capacity of treatment facilities whereas observed environmental weaknesses of the pattern may provide the impetus for beautification concepts to be included in the overall treatment plant design.

Determination of water resource requirements is based on modeling the relationships between land use and the water-related needs. Residential demand for water supply is thus modeled as a function of population and irrigable acres to account for both personal consumption and sprinkling. Identifying the relevant parameters for the determination of water resource requirements specifies one aspect of the information needed. Subsequently, a planner's understanding of existing systems, sources of supply, cost estimates and so forth are used to make a first assessment of the differences in system design and cost for each alternative pattern.

4. Simplified Framework as Applied to the Analysis Undertaken

The analysis presented in this paper is intended as a first approximation to the framework previously described. Using the scope of the SIMULATOR as presently available, limited data and time constraints, its objective is to provide an overview of the major alternative land use patterns' salient features and to make a preliminary assessment of their respective viabilities. In view of these considerations, the analysis concentrates on elements chosen on the basis of significance and analytical feasibility.

The economic analysis consists of three major components expected to be significant in this study: site development costs, transportation costs and fixed area development costs. The social analysis examines the impact of emigration, deficiency of low income housing and deficiency of employment proximate to the downtown area. As environmental impacts are treated in a

companion paper prepared by the Omaha District, they are not covered here.

Due to the structure of the analytical tool used, much of the consistency analysis discussed is facilitated. Items such as the internal consistency between density, population and acres required are an integral part of the model. Furthermore, due to the model's allocation process many checks concerning the logic of development are accounted for.

Two important water resource requirements are examined: (1) demand for water supply, and (2) wastewater loadings from residential, commercial and industrial point sources. These requirements were chosen because of their heavy dependence upon land use. In addition, the analysis examines the total potential benefits due to locational advantage that could be gained through flood protection. This information is useful in determining tradeoffs between structural and nonstructural protection alternatives.

C. <u>Relationship of the Land Use Analysis Approach to the Planning Process</u>

The Omaha Plan of Study outlines five major steps as key milestones of the planning process: need identification, generation of alternative programs, program analysis, display, and selection of a course of action. While this was suggested as the overall order of execution, it was also discussed that the first four steps should be performed in an iterative manner. As outlined in the Plan of Study, the first iteration includes: a broad identification of needs, primarily as related to key concerns and preferences; a broad delineation of alternative land use patterns and associated water resource programs emphasizing overall direction; a preliminary analysis relating each water resource program to identified needs; and a first order display of analytical results assessing program feasibility and major impacts.

It is noted that performing the land use analysis previously described accomplishes one iteration of the four steps, i.e., formulation and specification of alternative patterns to be analyzed depends upon expressed concerns and preferences; assessment of water resource requirements is the first step in defining alternative water resource development programs; assessment of strength and weakness, and consistency analysis is part of program analysis; presentation of analytical results associated with each pattern is part of display. Subsequent iterations are associated with increasing levels of

analytical detail. More specifically:

- Need Identification. The planning process identified two important elements of this step: derivation of planning objectives and resource requirements. Formulation, specification and analysis of land use patterns provides for both: (1) formulating patterns to be analyzed reflects broad concerns and preferences while assessing major impacts provides necessary information to delineate specific planning objectives and relative priorities; (2) similarly, pattern specification reflects land requirements which together with population data are used to define water resource requirements. Obviously, as land use patterns are specified and analyzed in increasing detail, the need identification step converges.

- Alternative Programs. Water resource programs are formulated in increasing detail (1) as water resource requirements are more precisely defined in terms of magnitude and spatial distribution, and (2) as a pattern's key strengths and weaknesses are better translated into objectives for water resource system design.

- Program Analysis. Assessment of pattern impacts and consistency analysis are major determinants in program evaluation. Institutional analysis, water resource system costs and impacts are the remaining considerations.

- Display. The display step mainly deals with the presentation of system benefits and costs. Within the multiobjective planning framework benefits include economic, social and environmental program impacts. Aspects of these are contained in the land use analysis as previously described. System costs must be treated as a separate topic.

Chapter III

FORMULATION AND SPECIFICATION OF TWO ALTERNATIVE LAND USE PATTERNS

A. Introduction

Currently land use planning is largely the domain of local government; thus land use plans are specified at a sufficient level of detail and scope to satisfy their needs. However, this level of detail and scope may be insufficient for the water resource planner. Hence, the comprehensive plans of most urban areas normally need to be expanded in terms of the breadth and depth of elements used to characterize it that are important to water resource planners. In addition, portions of such plans are often outdated with little likelihood of revision in the near future. Consequently, the water resource planner is usually confronted with the task of adding specificity, enlarging the scope or revising outdated portions of existing land use plans.

A second but related issue is that local governments normally project one land use pattern that represents the "best estimate" of the future. Other groups, factions, or even members of the local government or planning bodies may have different ideas concerning how the area will or should develop. These views are rarely documented in the local government's comprehensive land use plan. Recognizing the uncertainty that currently exists in regard to forecasting or directing future land use and the possible diversity of opinion concerning how the region should develop, a single estimate of future conditions may not be sufficient for the water resource planner. Thus, an important concern is the impact of uncertainty and diversity of opinion regarding future land utilization on water resource development. In response to this concern, the planner must formulate alternative futures which encompass alternative projections, assumptions or preferences. This is not to critique or disagree with any one plan, but rather to allow analysis of the impact of acknowledged uncertainty and diversity of opinion on water resource development. Thus formulation of alternative land use patterns is structured to satisfy two criteria:

- Alternative patterns should be specified at a sufficient level of detail and of broad enough scope to allow the assessment of information deemed necessary to design water resource systems responsive to the pattern's key attributes.

. Alternative patterns should be formulated so as to encompass major uncertainties or differences of opinion concerning the area's alternative futures.

Because the Omaha Plan of Study provides a detailed description of the physical and socioeconomic characteristics of the study area, this chapter mainly addresses formulation of the alternatives and their specification as needed for the analysis performed. Specifically, Section B describes the formulation of two major land use alternatives for the Omaha-Council Bluffs metropolitan area that meet the above criteria. The purpose of this section is to discuss not only the salient differences between the alternatives, but also the manner in which the alternatives are formulated. It is shown that Alternative A is largely the replication of the MAPA Comprehensive Land Use Plan and Alternative B represents a synthesis of alternative assumptions concerning the development of Omaha, Council Bluffs and the Missouri Riverfront Corridor.

Sections C and D provide the specification of these two major alternatives. The important variables in this specification are residential density, geographical distribution of population, direction of growth and location of employment centers. The data sources used and the assumptions made are also described in these sections.

B. Formulation of Alternative Land Use Patterns

There are currently four groups who are heavily involved in planning the future land use of the Omaha-Council Bluffs metropolitan area: Metropolitan Area Planning Agency (MAPA), Riverfront Development Program (RDP), and the planning departments of Omaha, Nebraska, and Council Bluffs, Iowa. Among these groups there is major diversity of opinion in regard to the area's future shape, particularly in respect to residential density and the location of residential, commercial and industrial activities. This difference of opinion centers upon whether the area will develop along the lines of current trends - increased suburbanization to the west and south at very low density - or whether a change will take place towards more dense development, coupled with intensive use of the riverfront.

In April 1971, MAPA adopted its Metropolitan Area Comprehensive Plan. This plan forecast development largely as a continuation of current trends which would

entail major expansion to the west and south of Omaha and decreasing residential density. This plan is presently adopted by the local Council of Governments and is taken as one alternative land use pattern referred to as Alternative A. The major critique of MAPA's plan has been the assumption regarding residential density. Residential densities advocated by the Omaha Planning Department range from 50% to 100% higher than those forecast by MAPA (Ref. 2). A change of this magnitude would obviously have major impacts on the total acreage of land required, the transportation network, cost of public services and water resource development.

Besides this difference of opinion regarding density, there is presently major controversy and thus uncertainty concerning the geographic distribution of the area's population. This is mainly due to RDP, which was conceived in 1970 and received study funds under the Integrated Grant Administration Program in 1972. RDP and the Omaha Planning Department envision new residential, commercial, industrial and recreational development along a 54 mile stretch of the Missouri. The key concept of this program is to shift emphasis from continued westward development to a "return to the river". While the magnitude of the program relative to total future development is rather small, it could have major social and economic impacts on significant areas of the city.

A third area of uncertainty is the growth of Council Bluffs. Historically, Council Bluffs has grown at a slower rate than the City of Omaha and the Omaha-Council Bluffs SMSA. Under the assumption of less westward growth, coupled with RDP and more aggressive local development on the Iowa side of the Missouri, there is the possibility of changing this trend to a situation where Council Bluffs would grow at a rate comparable to that of the SMSA. If the growth rate of the entire SMSA remains as presently predicted, such change in the projected growth rate for Council Bluffs would alter the forecasted distribution of population within the SMSA.

There are definite interdependencies in the aforementioned areas of uncertainty. Retardation of westward growth through an overall increase in residential density would improve the viability of the riverfront development which in turn is a major factor in the growth of Council Bluffs. Because of these interdependencies, the three key issues - increased density, riverfront development and increased growth for Council Bluffs - are synthesized into one alternative

referred to as Alternative B. In this manner Alternatives A and B encompass the major uncertainties and differences in opinion regarding future development of the area. If there were not a strong interaction between the assumptions, it would be necessary to formulate more major alternatives so that each alternative pattern represented a consistent but distinct view of the future. The interdependencies, however, permit treatment of these key issues through sensitivity analysis of the two major alternatives. In summary:

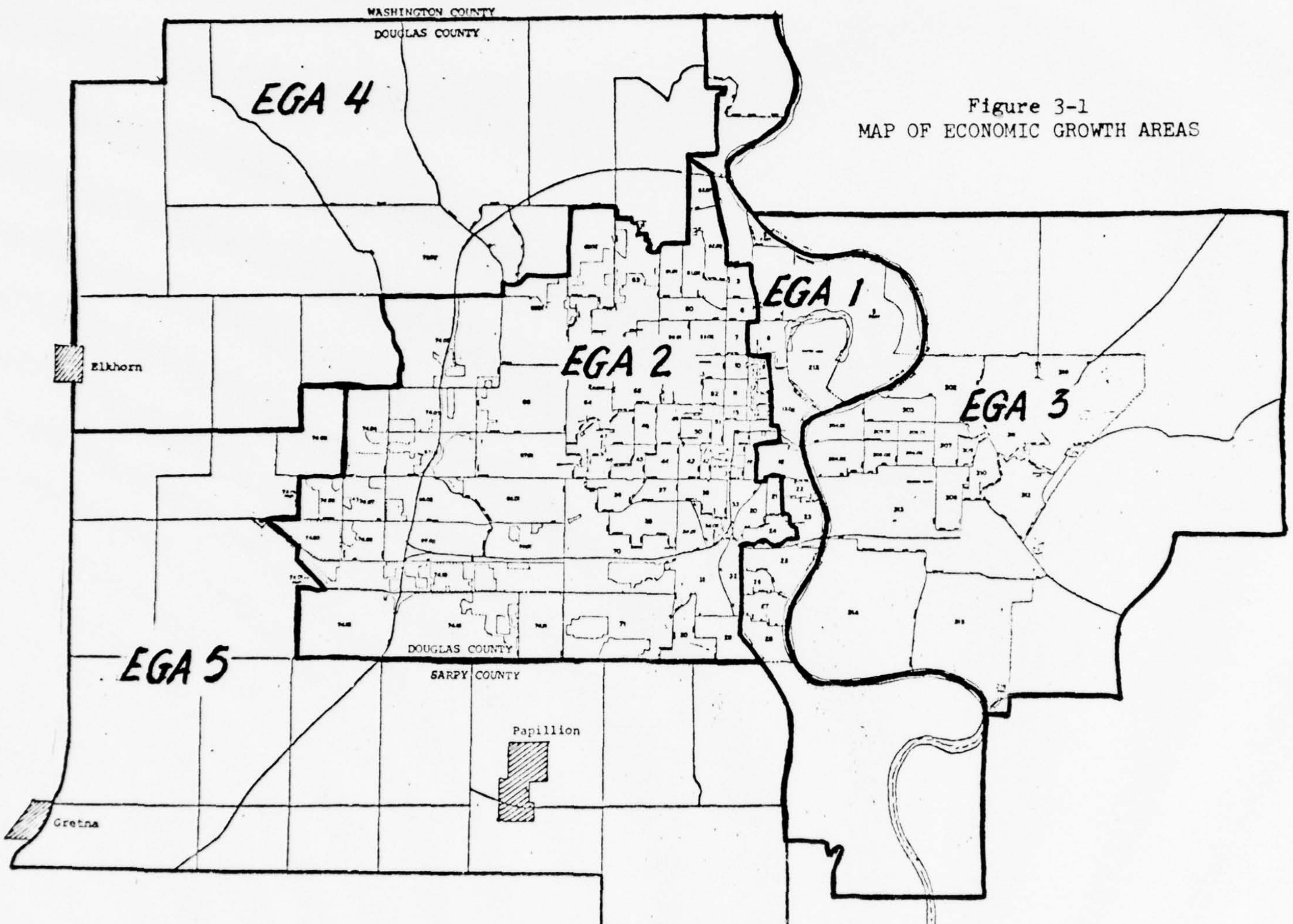
- Alternative A represents a continuation of present trends and is essentially the same as the MAPA forecast of future land use.
- Alternative B emphasizes higher density residential development, and shifts new development to the river, to existing residential areas in Omaha, and to Council Bluffs.

To facilitate the comparative analysis, Economic Growth Areas (EGA's) have been defined for the area under study. The EGA's are shown on the map in Figure 3.1. The EGA's are made up largely by census tract to facilitate data collection. EGA 1 represents the area on the Nebraska side of the Missouri and one area in Iowa that are directly affected by the RDP concept. EGA 2 represents existing Omaha Development, approximately bounded by I-680 to the north and west and the Douglas Sarpy line to the south. EGA 3 represents the Council Bluffs area. EGA 4 represents the area to the north and northwest of current development, and EGA 5 represents the area to the south and southwest of existing development. These areas were chosen on the basis of relatively homogeneous growth patterns and relative independence of each other.

Under Alternative A, EGA's 1 and 2 do not experience much growth; for the purposes of this study it is assumed that there is no growth in either area, thus creating a polar situation. EGA 3 experiences minor growth, while EGA's 4 and 5 contain the major portion of the growth. The key implications of this are that new utilities and roads will have to be built to service EGA's 4 and 5, while social and economic conditions in the downtown area of Omaha are expected to continue to decline as they have over the past decade. These implications are analyzed in the next chapter.

By contrast, Alternative B emphasizes growth in EGA 1 and 2, and thereby would be expected to also stimulate growth in EGA 3. The total population of

Figure 3-1
MAP OF ECONOMIC GROWTH AREAS



the area is assumed constant under both alternatives, so there would be less growth in EGA's 4 and 5 under B than under A. This population projection (see Table III-1) is based on U.S. Bureau of the Census Series D populations to the year 2000, and MAPA projections of 10 percent growth from the year 2000 to 2010 and 9 percent from 2010 to 2020 (Ref. 3). Major possible implications of Alternative B are a revitalization of downtown Omaha, with consequent relief of housing and employment problems for the low-income population, and less need for new road and utility construction because of more dense population.

Table III-1

SMSA POPULATION PROJECTIONS

Year	Population
1970	540,142
1980	640,865
1990	755,271
2000	869,708
2010	956,679
2020	1,042,780

C. Specification of Alternative A

1. Residential Location

The two alternatives differ in distribution of population and in location of employment. The basic assumptions in Alternative A are:

- Approximately all increases in development will occur outside the area of existing development; thus there is not any increased development in EGA's 1 or 2. For residential development this assumption is consistent with the procedure used to formulate the MAPA plan; however, it represents a deviation from the MAPA plan which assumes modest commercial and industrial development.
- EGA's 4 and 5 will share the projected growth of Douglas and Sarpy Counties in proportion to the distribution of residential land forecast by MAPA.
- The growth in EGA 3, Pottawattamie County, will be as projected by the Census Bureau and MAPA.

Table III-2 summarizes the population over time by county and by EGA.

Table III-2

POPULATION PROJECTIONS FOR ALTERNATIVE A

a. By County

Year	County		
	Douglas	Sarpy	Pottawattamie
1970	389,455	66,200	86,991
1980	442,197	102,538	96,130
1990	506,032	143,502	105,737
2000	565,310	191,336	113,062
2020	655,343	261,336	126,101

b. By EGA

Year	EGA				
	1	2	3	4	5
1970	57,860	338,555	65,299	9,078	28,364
1980	(no change		72,447	44,151	77,917
1990	assumed)		80,351	86,601	135,026
2000			88,176	126,022	197,363
2020	57,860	338,555	101,632	185,894	289,522

2. Land Use Requirements

For each alternative the acreage required for residential, commercial and industrial growth is allocated to subareas within each EGA either by directly specifying acres or by calculating acres from population and density. In the case of Alternative A the following assumptions hold for the densities used to determine residential acres:

- The average household has 3 people.
- Low density assumes 1/2 acre lots and a net residential density of 6 people per acre.
- Medium density assumes 1/4 acre lots and a net density of 12 people per acre.
- Residential acreage constitutes 2/3 of community development; the remaining 1/3 is allocated to roads, local commercial and open space. The resulting community development densities are 4 people per acre for low density, 8 people per acre for medium density.

The proportion of acres assigned to low and medium density development are determined by setting the combined residential density in each county equal to the densities assigned by MAPA in its projections. For Douglas and Sarpy Counties the MAPA value is 6.5 people per acre, and in Pottawattamie, 5 per acre. Thus, Table III-3 summarizes the proportions of low and medium density development by county that result in the above MAPA densities while Table III-4 shows the corresponding acreage for the EGA's.

Table III-3

RESIDENTIAL DENSITIES FOR ALTERNATIVE A

Density	Proportion of Acres (Percent)		Proportion of Population (Percent)	
	Douglas and Sarpy	Pottawattamie	Douglas and Sarpy	Pottawattamie
Medium	62.5	25	76.9	40
Low	37.5	75	23.1	60

Table III-4

NEW RESIDENTIAL ACRES REQUIRED

Year	EGA 1 Low	EGA 1 Middle	EGA 2 Low	EGA 2 Middle	EGA 3 Low	EGA 3 Middle	EGA 4 Low	EGA 4 Middle	EGA 5 Low	EGA 5 Middle
1980					1090	363	2042	3399	2866	4770
1990	(Alternative A assumes no new residential acres in 1 and 2)				2235	745	4493	7478	6184	10293
2000					2834	945	6739	11217	9803	16318
2010					3434	1145	8475	14107	12367	20585
2020					5450	1817	10211	16996	15082	25104

Table III-5

NEW COMMERCIAL AND INDUSTRIAL ACRES FOR ALTERNATIVE A

Year	EGA 1 C*	EGA 1 I*	EGA 2 C*	EGA 2 I*	EGA 3 C*	EGA 3 I*	EGA 4 C*	EGA 4 I*	EGA 5 C*	EGA 5 I*
1980					25	85	318	252	336	855
1990					51	173	700	554	726	1845
2000					79	266	1269	832	1151	2925
2020					125	423	1590	1260	1770	4500

* C = Commercial

* I = Industrial

Commercial and industrial growth is based on extending MAPA's 1995 projections to the year 2020 at the same rate as the population increases. Table III-5 shows the new acres for each EGA in each category. It should be noted that only major commercial developments are included in these estimates. Local commercial activities are assumed to be part of residential development.

D. Specification of Alternative B

1. Residential Location

The major difference between the alternative land use plans is that under Alternative B there is increased density and an increase in population allocated to EGA's 1 and 2 and 3 coupled with decreased growth in EGA's 4 and 5. The basic assumptions in Alternative B are:

- RDP in EGA 1 will account for 8 percent of the increase in population of Douglas and Sarpy Counties by the year 2020. This is based on total RDP development.
- Beginning in 1980, Council Bluffs will grow at the same rate as the rest of the SMSA rather than at its present lower rate.
- EGA's 2,4 and 5 will share the remaining population increases in proportions estimated by the Metropolitan Utilities District (MUD) in its projection of population growth to the year 2020. That projection assumes an overall increase in density for areas with existing development.

The resulting populations are listed in Table III-6 by EGA.

2. Land Use Requirements

The following residential densities are assumed for Alternative B:

- Medium densities of 12 people per acre and high densities of 25 people per acre are used for EGA 1. Medium density represents cluster development, infill housing redevelopment and new towns in general. High density represents planned unit development (Ref. 4).
- For all other EGA's, a residential density of 8 people per acre is used. The schedule of residential development is shown in Table III-7.
- Commercial and industrial development is based on land identified by the RDP and projections made by MUD. This development is assumed to take place according to the schedule shown in Table III-7.

Table III-6

POPULATION GROWTH FOR ALTERNATIVE B

Year	EGA 1	2	3	4	5
1970	57,860	338,555	65,299	9,078	28,364
1980	64,265	368,135	72,449	27,696	57,944
1990	71,631	402,152	83,386	48,966	91,961
2000	78,677	434,689	98,318	69,866	124,498
2020	89,886	486,454	117,878	102,043	176,263

Table III-7

NEW ACREAGE REQUIREMENTS

a. Residential

Year	EGA 1		2	3	4	5
	Middle (12/acre	High (30 acre)	Middle (8/acre)			
1980	427	43	3,697	894	2,327	3,697
1990	918	92	7,949	2,261	4,986	7,949
2000	1,388	139	12,017	3,194	7,599	12,017
2020	2,135	214	18,487	6.572	11,621	18,487

b. Commercial and Industrial

Year	EGA 1		2		3		4		5	
	C*	I*	C*	I*	C*	I*	C*	I*	C*	I*
1980	15	400	220	40	35	112	180	180	240	500
1990	23	860	473	86	85	272	387	387	516	1,075
2000	30	1300	594	130	158	504	585	585	780	1,625
2020	30	2000	715	200	250	800	900	900	1,200	2,500

*C = Commercial

*I = Industrial

Chapter IV

ANALYSIS OF ALTERNATIVES

A. Introduction

The comparative analysis of the land use alternatives is performed primarily on the basis of the aforementioned computer simulation model. Specifically, the model is used to calculate results related to a pattern's economic impacts, to check internal consistency of the alternatives and to calculate aggregate water resource requirements. Analysis of social impacts is performed externally to the model.

Section B presents the analysis results and highlights salient differences between the two alternatives as specified in Chapter III. The objective is to set forth the two patterns and their implications according to the simplified framework summarized in Chapter II. Therefore, the section presents economic and social impacts, briefly discusses pattern consistency and outlines respective water resource requirements.

A key difference between the two alternatives is the density of residential development. Section C presents several case studies where the sensitivity of economic impacts and water resource requirements to variations in density and population are examined. The objective is to display the implications of higher densities and different growth rates on the choice between alternatives. The last case study is designed to provide information as to the Riverfront Development Program's viability.

B. Comparative Analysis of the Basic Alternatives

Analysis results are displayed in this section according to the simplified framework presented in Chapter II. For each alternative, major strengths and weaknesses are reflected in terms of aggregate economic and social measures; internal consistency of the alternatives is discussed on the basis of the simulation model's analysis logic; and water resource requirements are determined for water supply, wastewater loadings and flood plain management.

1. Economic and Social Impacts

a. Economic

The main purpose of the economic analysis is to assess the difference in National Economic Efficiency (NEE) benefits between two alternative patterns. No assessment of the distribution of benefits is attempted. The basic tool used in the analysis is the SIMULATOR. An overview of the approach employed is given below, while a more detailed description of the model can be found in Reference 5.

NEE benefits attributed to a development pattern are measured in terms of annual net earnings to both landowners and individual activities. Thus, the net earnings, or economic rent, of an activity at a certain location is given by the difference between the activity's gross income and its total cost. Hence, the total NEE benefits associated with a pattern are given by the sum of the economic rents over all activities and locations.

In most situations, the planner is interested only in the difference in NEE benefits between development patterns. Calculating this difference is easier since many components of economic rent do not vary between patterns and therefore need not be calculated. Identifying such similarities prior to a detailed evaluation reduces the scope of analysis considerably. For example, if it is assumed that the mix and magnitude of activities are the same under either alternative, then all components of economic rent which are independent of location can be eliminated. For the analysis undertaken in this paper, it is assumed that each alternative land use pattern with the same population generates the same gross income; i.e., the alternatives are not sufficiently different to generate a significant difference in gross income. Given this assumption, differences in NEE benefits are due solely to differences in costs. These cost differences stem from three main sources: site development and construction, transportation, and fixed area development.

Differences in site development costs are due to differences in the cost of site preparation, such as clearing, grubbing, excavation and trenching. Site development costs vary both with the type of activity and the location, while construction costs vary with the type of structure and activity mix. Transportation cost is a function of travel time and distance, reflecting both

cost of travel time to the individual and cost due to the means of transportation. This paper only considers the cost of commuter travel to and from work. Since the major difference between alternatives is residential density, this aspect of transportation cost can be expected to exhibit significant variance. The "home-based work" trip represents approximately 20% of the total; other transportation costs such as those incurred by individuals going shopping or recreating or by commercial and industrial activities are assumed to be approximately equal with either alternative and therefore cancel out. Fixed area development cost refers to the initial investment of providing the main interconnections for a new development area with the existing system of roads, power, water and sewage. These costs are derived externally to the SIMULATOR.

Table IV-1 displays key characteristics and some economic implications of the two alternatives. It is observed that while both patterns accommodate the same growth, Alternative A follows current trends in terms of overall density and residential mix; in addition, Council Bluffs exhibits smaller growth, the Riverfront remains undeveloped and virtually all growth is accommodated outside the present city limits.

Alternative B exhibits $12.9 million more in NEE benefits than Alternative A. Thus, from an overall economic point of view, Alternative B is preferable to A.

As indicated in Table IV-1, the difference in NEE benefits consists of Alternative B's reduced site development and construction costs and lower transportation cost. The difference in fixed area development costs is comparatively insignificant (Ref. 6). The site development cost of A is higher than B due to increased cost for local services required by lower density development of A and decreased cost for back fill development of B due to existing utilities and roads within present city limits. The construction cost of B is lower because it has more apartments rather than primarily single family residences as in A. The difference in transportation costs is due to the increased travel time and distance, in terms of commuting to and from employment, that result from the reduced density of Alternative A. Transportation cost is calculated by allocating poeple in each subarea to major employment centers of each pattern and determining the time and distance from the subarea to each center. Travel time is valued at $1.50/hour and running costs at $0.10/mile.

Table IV-1

COMPARISON OF BASIC ALTERNATIVES

	(1) Population Increase	Average Residential Density	(2) Residential Mix	(3) Travel Time	(4) Population Distribution	(5) Difference in NEE Benefits Due To:
Alternative A	a. 473,500 b. 1.3%/year	6.3 people/acre	a. 27% b. 73% c. -	13.7	a. 7.5% b. - c. - d. 92.5%	a. $93.9 b. $33.2
Alternative B	a. 473,500 b. 1.3%/year	8.2 people/acre	a. - b. 98.5% c. 1.5%	12.1	a. 11.2% b. 6.8% c. 31.2% d. 50.8%	a. $90.2 b. $24.0

(1) a and b represent change in population by the year 2020 and growth rate per year respectively

(2) a,b and c represent % of population in low (4 people/acre), middle (8 people/acre) and high density (25 people/acre)

(3) given as average minutes of travel time from residence to place of employment

(4) a,b,c and d represent % distribution of population in Council Bluffs, RFD, current Omaha City limits and suburban respectively

(5) a and b represent cost in $ million/year for site development and construction, and transportation respectively

b. Social

Social implications are analyzed on the basis of examining each alternative's socioeconomic impact on the city's low income areas. Throughout the following discussion, these areas are referred to collectively as the Impact Study Area. This area consists of census tracts with 20% or more families receiving incomes below the poverty level as shown in Figure 4.1. Conclusions reached are primarily based on examining current trends in population, housing and unemployment.

The major conclusion is that under Alternative A downtown Omaha, and the impact study area in particular, will probably continue its present trend of deterioration. Under Alternative B there is the potential, but no guarantee, for a reversal of that trend. For Alternative A the deterioration would be a continuation of present trends in population, housing and employment as follows:

- Population. The number of residents in the impact study area census tracts declined by as much as 50% in the decade 1960-1970. The greatest loss occurred in the 25-44 age group, the most productive segment of the population in economic and social activities. The impact area exhibits a trend towards increased proportions of low income, unemployed and undereducated people.

- Housing. There is a serious shortage of low income housing, with 11,000 households competing for only 1,700 units within their income ability in the area east of 30th Street (Ref. 7).

- Employment. Present trends indicate that the major proportion of new employment is locating on the western side of Omaha. In the impact study area 46.5% of the households are without cars; in addition, it is very difficult for many of these people to reach jobs on the western side of the city by bus because of the long commuting time involved.

Alternative B represents an opportunity to reverse these trends on the basis of the following observations:

- Population. With growth centering around the downtown and the Riverfront, there would be an incentive to redevelop deteriorating neighborhoods and reverse the current population decline.

- Housing. New housing of 8,600 units projected for the RDP alone would be primarily for middle and upper income people. However, relief for low income people would come from 270 units for the elderly and whatever percentage of the remaining 8,330 units that would be made available for low income occupancy.

- Employment. A total of 30,000 new jobs would be located within easy commuting of the impact study area with a range of job skill levels that would help reduce unemployment.

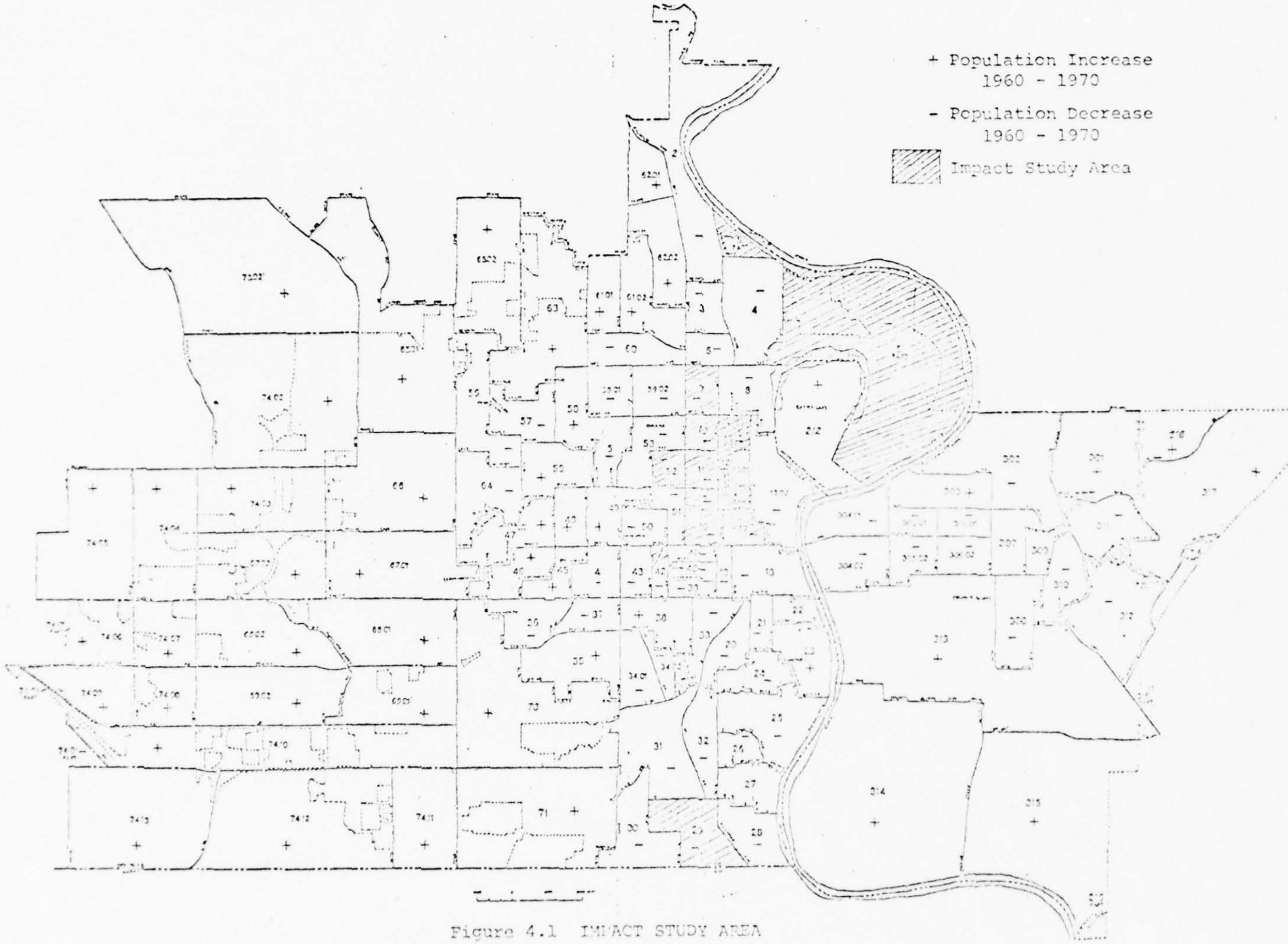


Figure 4.1 IMPACT STUDY AREA

Since a large, and increasing, proportion of the residents of the area are Negro, these problems and opportunities have a major impact on the minority community.

The following paragraphs provide the data base explaining the existing trends in population, housing and employment upon which the conclusions are based.

- Population. As shown in Figure 4.1, with one exception, the census tracts east of 30th Street in Omaha have lost population between 1960 and 1970. In the impact study area, some tracts lost on the order of 50% of their residents, and in the area as a whole there was a 37% decrease. Table IV-2 shows that a significant portion of the decrease occurred for people in the 25-44 year age bracket. The trends displayed in Table IV-3 provide a clear picture of the overall deterioration of the area.

- Housing. Housing construction has shifted in line with the population with most taking place in a semi-circle from the southwest to the northwest part of the city. As most new units are being built for families with incomes of $12,500 or more (Ref. 7), this construction is aimed primarily at middle and upper income households. In the impact study area, there has been a reduction of housing units from 5,000 in 1960 to 3,400 in 1970. As dilapidated and deteriorated dwellings are demolished, there have not been low priced replacements. As previously stated, in 1972 the area east of 30th Street contained 11,000 households competing for only 1,700 units within their income ability. Table IV-4 shows that within the impact study area on the order of half the families in the income group below $5,000 pay 35% or more of their income for gross rent.

- Employment. The major concern with the unemployment problem in the impact study area is that westward expansion has attracted employment away from downtown, making it more difficult for area residents to commute to work, particularly when they do not have access to a car and must rely on public transportation. Evidence of the employment shift away from the downtown area is given by data in Reference 9 on the availability of office space, and by census data on total employment (Ref. 8). The proportion of suburban office space has grown from 6% in 1960 to 25% in 1973, and the average annual growth rates for office space have been about 3.0% for the city and 48.1% for the suburbs. Census data on employment location show that in 1960 some 70% of the employed population of the SMSA worked in the city. By 1970 that proportion had dropped to 66%, despite the annexation of surburban areas. Also, substantial industrial development has taken place in the northwest portion of Omaha, and between Interstate 80 and L Street (Ref. 10).

Table IV-2

COMPARISON OF AGE DISTRIBUTION OF IMPACT STUDY AREA VS SMSA(Ref. 8)

IMPACT STUDY AREA

	≤24	25-44	45+
1970	51.5	18.4	30.0
1960	48.5	23.5	28.1
1950	40.5	29.7	29.8

SMSA

	≤24	25-44	45+
1970	49.0	24.4	26.6
1960	45.8	26.5	27.8
1950	39.9	29.7	30.4

Table IV-3

TRENDS IN THE IMPACT STUDY AREA (ISA), (REF. 8)

	Population Total	Population As % of SMSA	Population As % of Omaha	Median Income ISA	Median Income SMSA	Unemployment ISA	Unemployment SMSA
1970	29,359	5.4	8.5	3,441	8,288	7.5	3.0
1960	46,303	10.1	15.4	3,364	5,325	6.5	3.0
1950	47,737	13.0	19.0	2,152	2,922	4.7	2.6

	% Households Without a Car ISA	% Households Without a Car SMSA	Median House Price-Single Owner ISA	Median House Price-Single Owner SMSA	Median Rent ISA	Median Rent SMSA	Median Years of Schooling ISA	Median Years of Schooling SMSA
1970	46.3	15.2	7,200	14,900	61	94	10.2	12.3
1960	43.2	18.9	6,800	11,600	53	67	9.7	12.0
1950	N.A.	N.A.	5,000	7,100	36	42	9.8	11.0

Table IV-4

PERCENTAGE OF RENTERS WITHIN ISA
PAYING 35% OR MORE OF INCOME FOR GROSS RENT

Census Tract	Less than $5000	Income $5000-9999
5	37.7	5.6
7	46.5	-
9	55.2	-
10	40.0	-
11	48.5	-
12	35.3	-
14	41.4	-
15	60.3	-
16	57.4	9.0
17	37.6	1.7
29	46.4	2.7
52	45.3	1.9
SMSA	56.0	4.2

Table IV-5

RACIAL MIX OF THE ISA

% Negro

	ISA	SMSA
1970	56.2	6.8
1960	42.5	5.7
1950	29.7	4.7

Because of the trend to locate employment away from downtown Omaha, the availability of either private or public transportation is an important consideration for residents of the impact study area. Table IV-3 shows that in 1970 46.5% of the area's households were without cars compared to 15.2% for the SMSA. For those without cars, Metropolitan Area Transit (MAT) bus service connects the impact study area with employment centers. However, commuting times to western employment locations from the north Omaha area are high. For example, to get from census tract 12 at Bedford and 30th Streets to either the center at 90th and L Streets or the Western Electric plant beyond 120th Street takes an hour and 20 minutes and includes one bus change (Ref. 11). Assuming 10 minutes getting to and from the bus stop, the daily round trip commuting time for some residents is three hours. As major changes in public transit that would significantly reduce these travel times are not likely at the present time, it is important that jobs be located near downtown if there is going to be a major reduction in unemployment for the impact study area.

- Minorities. The proportion of Negroes in the impact study area is as high as 97% in some census tracts, and the area contains all the tracts in the SMSA with 80% or more Negro. Hence the deteriorating conditions of the impact study area have a disproportionate impact on the Negro population (see Table IV-5).

2. Consistency Checking

The objective for checking a pattern's consistency is to assure that the pattern is credible and there are no major discrepancies and errors. Within this context there are two types of consistency checking: internal and external.

a. Internal Consistency

The use of the SIMULATOR provides the logical framework that insures the internal consistency of each pattern analyzed. With this tool, the planner need only concern himself with the validity of individual assumptions made. The basic alternatives presented in this paper are consistent in regard to the following:

- Population, density and land requirements.
- Allocation of land requirements among residential, commercial and industrial uses.
- Distribution of population over the entire study area.
- Allocation of community land to residences, local commercial, streets, and open space.

In addition to the above, the use of the SIMULATOR assures the planner of the overall reasonableness of a pattern in terms of the development sequence exhibited. This is accomplished through the program's allocation process that develops the most valuable land first. The program analyzes each EGA independently; thus, the allocation process is not applied to the entire pattern. In order to check the consistency of the initial allocation of population and activities per EGA, the value per residential unit is plotted over the planning period as shown in Figure 4.2. If it is observed that the trend of values per unit over time for one EGA is substantially different than the others, the validity of the initial allocation among EGA's should be questioned. Such examination may show that the initial allocation forced growth of that EGA when there is a more economic choice in one of the other EGA's. Figure 4.2 shows that such inconsistency does not exist in the alternatives, except possibly for the early time periods in EGA 4.

b. External Consistency

This type of consistency deals primarily with projections for which discrepancies can only be identified on the basis of comparisons with national trends and analysis of general conditions in the area. Such projections include overall population growth, mix of residential, commercial and industrial activities, general type of development and so forth. The basic alternatives analyzed are comparable to national averages in terms of such parameters and, therefore, external consistency does not appear to be an issue.

3. Water Resource Requirement

This section displays results of the two patterns' influence on water resource requirements. In particular, the two basic alternatives are analyzed in terms of their implications on demand for water supply, wastewater loadings and need for structural flood control. The sensitivity of water supply demand and wastewater loadings to residential density is also displayed.

a. Demand for Water Supply

Water supply requirements associated with each alternative are estimated in terms of average day demand, maximum day demand and peak hour demand. These parameters affect the design of storage, transmission and local distribution

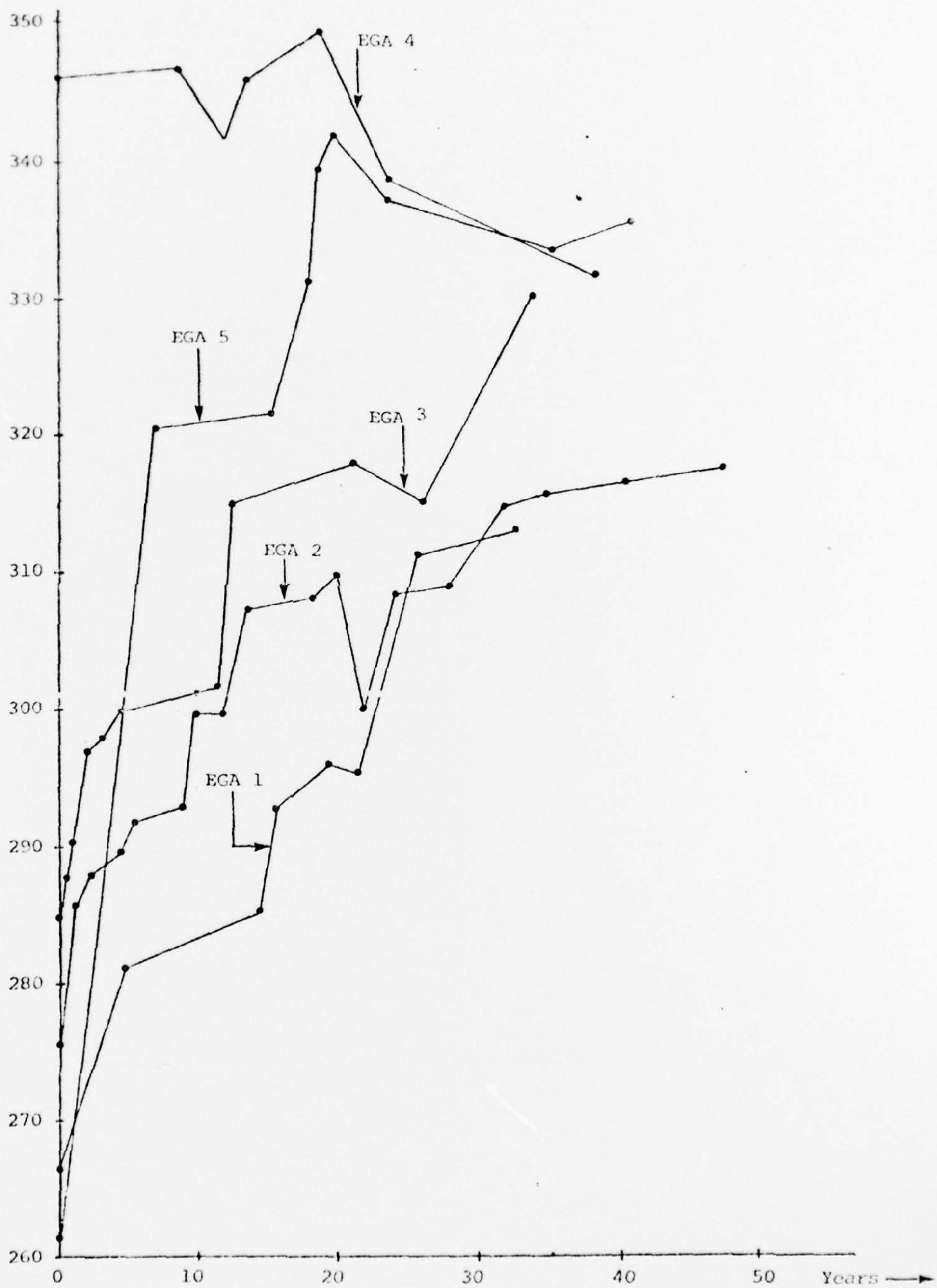


Figure 4.2 VALUE PER RESIDENTIAL UNIT FOR EACH EGA

facilities, respectively. Hence assessment of the effect of alternative land use patterns on each of these components is significant in view of their different implications for water supply system design. The results of the analysis are shown in Table IV-6.

Unlike the estimates of commercial and industrial demands, which are identical to the Omaha Metropolitan Utility District's (OMUD) forecasts, the estimate shown for residential demand is different. OMUD's residential water use forecast is given in terms of average per capita use without differentiation between consumptive and sprinkling uses; in addition, the forecast is based on an increase in per capita use over time without specific reference to a land use plan's population density. To account for variation in population density, forecasts must differentiate between domestic consumption and sprinkling use (Ref.12). Domestic consumption is nonseasonal and accounts for such uses as cooking, cleaning and personal hygiene. Sprinkling use is seasonal and refers principally to watering lawns. Therefore, consumptive use is independent of residential density whereas sprinkling is not. Coefficients for estimating the two components were obtained from OMUD's 1970 water usage data for Omaha (Ref. 13). Analysis of this data shows that for Omaha the seasonal sprinkling in an average day is about one-third of the consumptive use, while in a peak day and hour it is about one-half. The sensitivity of this demand on residential density is quite significant as shown in the differences for peak day and hour between Alternatives A and B (see Table IV-6).

b. Wastewater Loadings

Wastewater loading estimates associated with the alternative patterns are based on assumptions and data obtained from MAPA (Ref.14). Key assumptions for average daily flows are as follows:

- Domestic: 110 gallons/capita/day (gpcd).
- Commercial: 1000 gpd/acre of commercial land use.
- Industrial: 1200 gpd/acre of industrial land use.
- Infiltration: 500 gpd/acre for gross developed acres with separate storm and sanitary sewers; 1000 gpd/acre for combined sewers.

Table IV-6

YEAR 2020 WATER SUPPLY AND WASTEWATER LOADING REQUIREMENTS (in MGD)

	Alternative A	Alternative B	Double Density Alt.A	Double Density Alt.B	Very High Density	High Density, Double Growth
	a. 473.5 b. 6.3	a. 473.5 b. 8.2	a. 473.5 b. 12.6	a. 473.5 b. 16.4	a. 473.5 b. 66.0	a. 947.0 b. 66.0
Water Supply:						
. Average Day	80.66	75.14	69.80	67.43	62.98	106.63
. Peak Day	203.34	167.72	132.29	117.28	87.63	136.59
. Peak Hour	289.74	234.54	179.63	156.38	110.41	162.83
Wastewater Loading:						
. Average Day	101.84	96.89	86.58	84.31	71.51	127.28

a. Change in population by year 2020 in (000)

b. Average residential density in people/acre

Since the basic alternatives in Table IV-6 have the same mix of residential, commercial and industrial activities, the difference in loading between patterns is solely due to infiltration. This is not a significant factor as is seen from the variation of wastewater loadings with density; the difference between total flows under Alternatives A and B is 5%. A more important impact may result from the location of waste loadings. Table IV-7 shows the flows for each EGA under both alternatives. These flows are only due to new development and they do not include existing sources.

Table IV-7

WASTEWATER AVERAGE DAY LOADINGS (MGD)

EGA	Alternative A	Alternative B
1	--	8.5
2	--	29.4
3	8.6	9.5
4	37.6	17.9
5	55.7	31.6
Total	101.8	96.9

c. Flood Control

A preliminary investigation of a pattern's dependence upon structural flood control should examine whether there is demand for flood plain land due to scarcity of land in the area or whether flood plain lands exhibit locational advantage over other available land. There is an abundance of undeveloped land in Omaha; thus the only issue is the determination of locational advantage.

A quick assessment of locational advantage is obtained as follows. All flood plain lands within the 100-year flood contour contained in patterns A and B are zoned unavailable for future development. This is simulated using the computer program which locates all activities outside the 100-year flood contours. The same program then estimates the NEE benefits associated with the resultant pattern of development. The computer run is repeated with all flood lands available for development and with the assumption that there are zero damages or complete flood protection. The difference in NEE benefits for each pattern is an estimate of locational advantage. It is found that under Alternative A this locational advantage is about $250,000 per year and under B less than $100,000. No single EGA has benefits greater than $200,000 per year.

These results indicate that the benefits to be gained for allowing future development to locate in flood plain land under either land use pattern are negligible. Therefore, flood plains in the area which have negligible existing damages and do not exhibit major existing development should be zoned for future uses other than residential, commercial and industrial development. For flood plains exhibiting some existing development, flood plain management programs should be considered that combine structural and nonstructural measures. While these results are predicated upon relatively rough data, the implications are significant enough that they warrant a more detailed investigation.

C. Sensitivity Case Studies

In this section, variations of the two basic alternatives, reflecting a wider range of possible future choices, are formulated and analyzed. The main variations are due to different density and growth rates. Analysis of density changes is considered important since these represent significantly different styles of residential living. Analysis of different growth rates is important in view of existing discrepancies in population forecasts from various local agencies. In addition to the above analyses, a first attempt is made to investigate the viability of the Riverfront Development Program.

1. Doubling the Residential Densities

This study considers the implications of increasing densities in Alternatives A and B to 12.6 people/acre and 16.4 people/acre respectively. Table IV-6 shows the effect on water supply and wastewater loadings: significant

decreases in all categories. Table IV-7 shows the economic implications: site development and construction costs of both patterns are reduced by some \$6.3 to \$7.6 million a year whereas the difference remains essentially unchanged. Travel time to employment is marginally reduced and, analogously, the transportation cost is reduced by a few million dollars per year.

2. <u>Very High Residential Densities</u>

This study simulates the effect of a very high density - 66 people/acre - for both patterns. The results are displayed in Tables IV-6 and IV-9. The impacts are significant: peak day and peak hour water supply requirements are reduced by more than 50% and wastewater loadings by more than 30%; as anticipated, site development and construction costs for the two patterns are identical but there is a major difference in the transportation cost. This difference in transportation cost and travel time is explained by observing the change in population distribution; under Alternative B, the Riverfront absorbs 35% of the growth while suburban Omaha receives zero.

3. <u>Double Growth and Very High Density</u>

The objective of this study is to simulate the effect of double growth and very high density on both alternatives. Results for water resource requirements are shown in Table IV-6 and economic impacts in Table IV-10. The only major difference is in the transportation cost; locating high density in the suburbs negates the potential of reduced transportation cost. A consistency check on the EGA's will now show that the choice of EGA's for Alternative A is unreasonable, due to forcing very high density development in the suburbs when there are other more economic choices.

4. <u>Viability of the Riverfront Development Program</u>

This case study is designed to investigate the consequences of rapid growth of the Riverfront which is considered crucial if the RDP is to remain viable. This, of course, means that the program must capture a significant part of the housing market in a short time period. For simplicity of analysis it is assumed that the Riverfront must reach the level of development currently being planned for within ten years from program initiation. The simulation results show that this would imply one out of every four residences allocated to the

Table IV-8

DOUBLE DENSITY AND ORIGINAL GROWTH

	1 Population Increase	Average Residential Density	2 Residential Mix	3 Travel Time	4 Population Distribution	5 Difference in NEE Benefits Due To:
Alternative A	a. 473,500 b. 1.3%/year	12.6 people/acre	a. 27% b. 73% c. -	12.5	a. 7.5% b. 0 % c. 0 % d. 92.5%	a. $86.3 b. $31.0
Alternative B	a. 473,500 b. 1.3%/year	16.4 people/acre	a. - b. 98.5% c. 1.5%	11.4	a. 11.2% b. 6.8% c. 31.2% d. 50.8%	a. $83.9 b. $20.0

1 a and b represent change in population by the year 2020 and growth rate per year respectively

2 a,b and c represent % of population in low (8 people/acre), middle (16 people/acre) and high density (50 people/acre).

3 average minutes of travel time from residence to place of employment

4 a,b,c and d represent % distribution of population in Council Bluffs, RFD, current Omaha City limits and suburban respectively

5 a and b represent cost in $ million/year for site development and construction, and transportation

Table IV-9

HIGH DENSITY, ORIGINAL GROWTH IN POPULATION

	1 Population Increase	Average Residential Density	2 Residential Mix	3 Travel Time	4 Population Distribution	5 Difference in NEE Benefits Due To:
Alternative A	a. 473,500 b. 1.3%/year	66.0 people/acre	a. - b. - c. 100%	13.5	a. 11.1% b. 0 % c. 0 % d. 88.9%	a. $66.0 b. $29.5
Alternative B	a. 473,500 b. 1.3%/year	66.0 people/acre	a. - b. - c. 100.0%	8.5	a. 11.1% b. 34.8% c. 54.1% d. 0.0%	a. $66.0 b. $15.5

1 a and b represent change in population by the year 2020 and growth rate per year respectively

2 a,b and c represent % of population in low (4 people/acre), middle (8 people/acre) and high density (66 people/acre)

3 average minutes of travel time from residence to place of employment

4 a,b,c and d represent % distribution of population in Council Bluffs, RFD, current Omaha City limits and suburban respectively

5 a and b represent cost in $ million/year for site development and construction, and transportation

Table IV-10

HIGH DENSITY AND DOUBLE GROWTH RATE

	1 Population Increase	Average Residential Density	2 Residential Mix	3 Travel Time	4 Population Distribution	5 Difference in NEE Benefits Due To:
Alternative A	a. 947,000 b. 2.1%/year	66.0 people/acre	a. - b. - c. 100%	12.0	a. 11.1% b. 0 % c. 0% d. 88.9%	a. $124.9 b. $ 58.3
Alternative B	a. 947,000 b. 2.1%/year	66.0 people/acre	a. - b. - c. 100.0%	8.7	a. 11.1% b. 17.4% c. 71.5% d. - %	a. $122.4 b. 33.8

1 a and b represent change in population by the year 2020 and growth rate per year respectively

2 a,b and c represent % of population in low 4 people/acre), middle (8 people/acre) and high density (66 people/acre).

3 average minutes of travel time from residence to place of employment

4 a,b,c and d represent % distribution of population in Council Bluffs, RFD, current Omaha City limits and suburban respectively

5 a and b represent cost in $ million/year for site development and construction, and transportation

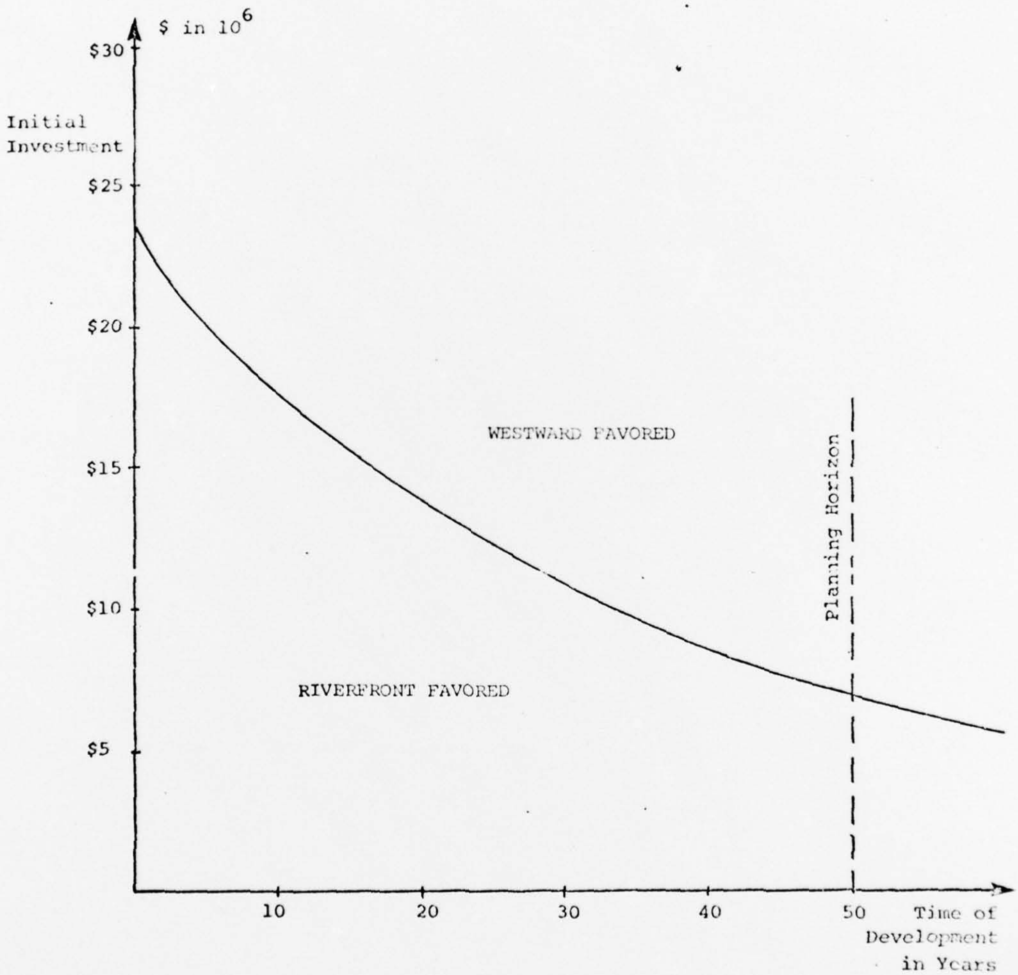


Figure 4.3 INDIFFERENCE CURVE FOR WESTWARD AND RIVERFRONT DEVELOPMENT AS FUNCTION OF TIME TO FULL DEVELOPMENT

Nebraska side of the Missouri in the next ten years will locate at the Riverfront. The crucial question is: Can the Riverfront capture such a large share of the market?

Another way of examining viability is to contrast the initial investment required for landscaping, construction and public works with the locational advantages of the development due to better access to employment than areas in the suburbs. These benefits are based on the level and time of development. If RDP develops to the level postulated (32,000 people) over a fifty year period, it would have locational benefits that were approximately $7 million greater than the same development occurring in the suburbs (Fig. 4.3). This is without accounting for initial investment. The faster RDP development occurs, the greater the locational benefits. From this analysis of potential benefits one can determine the tradeoff between development in the riverfront vs. development in the suburbs. For example, if the initial fixed costs necessary for RDP are $15 million (and one assumes that development elsewhere has no such costs) then the growth rate of RDP must be such that 32,000 people locate there within 17 years. If this rate can be achieved, then RDP is economically superior. Conversely, if this growth rate cannot be achieved in less than thirty years, then RDP must be able to generate this growth with an initial investment of $10 million or less to be economically justified.

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